**SYNOPSIS REGISTRATION**

**I. Student Details:**

1. Name of the Program:

2. Name of the Student:

3. Roll Number:

4. Session & Year:

5. Elective:

**A Deep Learning Approach to Classify Banana Diseases and Varieties Using Image Recognition**

**Introduction and Review of Literature**

Bananas are one of the most widely consumed fruits globally, contributing significantly to the agricultural economy. However, banana plantations are often affected by various diseases that impact both the yield and quality of the fruit. Additionally, there are several banana varieties that differ in size, shape, and appearance.

Traditionally, classifying banana diseases and varieties requires expert knowledge, which is a time-consuming and labor-intensive process. With the rise of artificial intelligence (AI) and deep learning, there has been a significant advancement in automating image-based classification tasks in agriculture. This project aims to develop an AI-driven solution to classify banana diseases and varieties based on image data using Convolutional Neural Networks (CNNs).

Recent studies have shown the effectiveness of deep learning in agricultural applications, such as plant disease detection, crop identification, and pest recognition. Works by authors such as Kamilaris et al. (2017) and Mohanty et al. (2016) have demonstrated the accuracy of CNNs in plant disease classification, achieving high levels of precision and recall.

The project aims to leverage a dataset containing images of banana leaves, using CNNs and pre-trained models like VGG16 and ResNet50 to classify banana diseases and varieties. The primary focus will be on implementing a two-level classification system: the first level will predict whether the image belongs to a disease or variety category, and the second level will further classify it into specific diseases or varieties.

**Objectives of the Study**

The primary objectives of the project are:

1. **To develop a deep learning model to classify banana images into two categories**: Disease or Variety.
2. **To build separate models for disease and variety classification**: Ensuring accurate identification of specific banana diseases and varieties.
3. **To evaluate the performance of different neural network architectures**: Comparing CNN, VGG16, and ResNet50 models in terms of classification accuracy.
4. **To implement data augmentation techniques**: Such as SMOTE to handle class imbalance and improve model performance.
5. **To assess the effectiveness of the model on real-world images**: Ensuring that the trained model can be deployed for practical use in banana plantations.

**Research Methodology and References:**

**Data Collection**: The dataset consists of banana leaf images, containing both healthy and diseased samples, as well as different banana varieties. These images are labeled as either belonging to the disease or variety category.

**Data Preprocessing**:

* The images are resized to 128x128 pixels to standardize input size for the models.
* Grayscale images are normalized to values between 0 and 1 to improve the training process.
* Data augmentation techniques are applied, such as rotating, flipping, and zooming, to artificially increase the size of the dataset.
* Additionally, the Synthetic Minority Over-sampling Technique (SMOTE) is applied to handle class imbalance.

**Model Development**: The following models will be used:

1. **First-Level CNN**: This model will predict whether the image belongs to a disease or variety category.
2. **Disease Classification Model**: For images classified as "disease," this model will predict specific banana diseases.
3. **Variety Classification Model**: For images classified as "variety," this model will predict specific banana varieties.

Models will be built using TensorFlow and Keras, with architectures including basic CNNs, pre-trained models like VGG16 and ResNet50, and fine-tuned versions of these models.

**Evaluation**:

* Accuracy, precision, recall, and F1-score will be used to evaluate model performance.
* A confusion matrix will be plotted to show how well the model distinguishes between different classes.
* The models will be compared to select the most optimal architecture.

**Tools and Technologies**:

* **Programming Language**: Python
* **Libraries**: TensorFlow, Keras, OpenCV, NumPy, Matplotlib, Scikit-learn, Streamlit
* **Deep Learning Framework**: Keras (for building CNN, VGG16, and ResNet50 models)

**References**:

1. Kamilaris, A., et al. (2017). "A survey of the applications of deep learning in agriculture." Computers and Electronics in Agriculture, 147, 70-90.
2. Mohanty, S. P., et al. (2016). "Using deep learning for image-based plant disease detection." Frontiers in Plant Science, 7, 1419.
3. Ribeiro, A., et al. (2019). "A deep learning approach for banana disease detection from images." Agricultural Engineering, 56(1), 50-60.

**DECLARATION**

*I hereby declare that this project synopsis is an original work carried out by me and has not been/will not be submitted to any other University for fulfilment of any course of study.*

Place:

Date:

*(\*Duly filled in application forms to be* ***signed by both the student and the Guide****. Forms must be* ***scanned in either .pdf/.docx format*** *and submitted with documentary proof through the LMS student’s login at appropriate assignment.)*

**(Signature of the Student)** **(Signature and name of the guide)**